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A preliminary study of handwear

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DEFENCE AND CIVIL INSTITUTE OF ENVIRONMENTAL MEDICINE

Technical Memorandum
DCIEM TM 1999-102
October 1999

National Defence Défense nationale

Canada

106-04061/

October 1999

DCIEM TM 1999-102

A PRELIMINARY STUDY OF HANDWEAR

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DEPARTMENT OF NATIONAL DEFENCE – CANADA

Executive Summary

A number of long-standing deficiencies in individual Canadian Forces (CF) clothing, and in particular handwear, have been identified. Clothe the Soldier (CTS) is a current project trying to overcome many clothing deficiencies, including those relating to handwear.

An Arctic Mitt, a Combat Glove with liner, and a Combat Vehicle Crewman (CVC) Glove make up the current CF handwear inventory. Within the CTS project, five gloves have been identified which will compliment or replace these items. It is proposed that an Extreme Cold Weather Mitt Liner will be added to, and integrated with the Arctic Mitt, to provide short term thermal protection in the cold while performing tasks which require dexterity/tactility. It is proposed that the Combat Glove will be replaced with two gloves, namely a Cold Wet Weather Glove for use when temperatures are around 0°C, and a Temperate Combat Glove for warmer weather. The CVC Glove will be replaced. A Mortarman Glove will be added to the Canadian Forces inventory as a new piece of kit.

Much of what appears in the SORs written for each of the five gloves described above, is anecdotal in nature, and therefore should be validated. Studies should be done to determine the proper ranking of handwear characteristics, and as such, identify which characteristics are most important to the soldier. The results of such studies will provide suggested amendments to the SOR, act as the input for a human factors assessment of handwear under consideration, and lay the foundation of a Request for Proposal from industry.

Three of the five types of handwear, namely Temperate Combat Glove, Extreme Cold Weather Mitt Liner, and Mortarman Glove, have recently been the topic of several focus groups. Groups of army personnel, mostly dismounted infantry, commented on current deficiencies and gave their opinions on what was required. Fit and durability were suggested as the two most important factors describing the Temperate Combat Glove. Gloves with a good grip (even in the icy cold) and with cold protection (for short periods of time) were the two characteristics most often used in describing a Mortarman Glove. It was more difficult to extract the most important characteristics of the Extreme Cold Weather Mitt Liner, but a warm glove (as opposed to a mitt), which allowed for a fair degree of dexterity would easily form the basis of such handwear.

Abstract

A number of long-standing deficiencies in individual Canadian Forces (CF) clothing, and in particular handwear, have been identified (1, 2, 4). Clothe the Soldier (CTS) is a current project trying to overcome many clothing deficiencies, including those relating to handwear. Three of the five types of handwear, namely Temperate Combat Glove, Extreme Cold Weather Mitt Liner, and Mortarman Glove, have recently been the topic of several focus groups, in order to determine the ideal characteristics of such handwear. Groups of army personnel, mostly dismounted infantry, commented on current deficiencies and gave their opinions on what was required. Fit and durability were suggested as the two most important factors describing the Temperate Combat Glove. Gloves with a good grip (even in the icy cold) and with cold protection (for short periods of time) were the two characteristics most often used in describing a Mortarman Glove. It was more difficult to extract the most important characteristics of the Extreme Cold Weather Mitt Liner, but a warm glove (as opposed to a mitt), which allowed for a fair degree of dexterity would easily form the basis of such handwear.

Introduction

A number of long-standing deficiencies in individual Canadian Forces (CF) clothing, and in particular handwear, have been identified (1, 2, 3). Some of the deficiencies have only recently become surmountable, through advances in material and integration technologies. Civilian items, and those now provided to some allied armies, are recognised as providing much better comfort, and environmental and abrasion protection, than those currently issued to Canadian Land Forces soldiers. An integral part of the omnibus Clothe the Soldier (CTS) project is meant to redress this situation.

A handwear rationalisation study was initiated in 1994. This study was conducted by Director Soldier System Program Management (DSSPM) and Director Land Requirements (DLR) staff as an opportunity to understand the relevance to current operations of over 30 styles of handwear currently in service. A series of meetings between DLR, Defence Research Establishment Ottawa (DREO), and DSSPM staff addressed reported capability deficiencies. Other capability deficiencies were identified through a Defence and Civil Institute of Environmental Medicine (DCIEM) questionnaire completed by troops deployed in the former Republic of Yugoslavia (4). A further focus group study was conducted in August 1996. Comments and assessments arising from these studies are incorporated in a recent Statement of Requirement (SOR) for a "Handwear System" (1).

Currently, an Arctic Mitt, a Combat Glove with liner, and a Combat Vehicle Crewman (CVC) Glove exist in the land force inventory. The main purpose of the Arctic Mitt is thermal protection, while the Combat Glove is used whenever manual dexterity and abrasion protection are required. Within the CTS project, five gloves have been identified which will complement or replace these items. It is proposed that an Extreme Cold Weather Mitt Liner will be added to, and integrated with the Arctic Mitt, to provide short term thermal protection in the cold while performing tasks which require dexterity/tactility. The CVC Glove will be replaced. It is proposed that the Combat Glove will be replaced with two gloves, namely a Cold Wet Weather Glove for use when temperatures are between -10°C and +10°C, and a Temperate Combat Glove for +10°C and up. A Mortarman Glove will be added to the Canadian Forces (CF) inventory as a new piece of kit. Although the proposed Arctic Mitt, Cold Wet Weather Glove, and Temperate Combat Glove are described as being designed for a specific temperature range, it is expected that in reality, there will be some overlap of temperature ranges in which each glove type can be used.

An SOR has been written for each of the five gloves described above. Much of what appears in these documents is derived from studies of a more general nature and anecdotal evidence of the deficiencies of the current handwear system. Studies should therefore be done to validate the requirements of each of the five glove types. Such studies should also determine a ranking, if possible, of the most important handwear characteristics for the soldier. The results of such studies will provide suggested amendments to the SOR, act as the input for a human factors assessment of handwear under consideration, and through this assessment, lay the foundation of a Request for

Proposal to industry. A study of this type on the Cold Wet Weather Glove has already been completed (5). No such study on the CVC Glove is known to this author, but a user acceptance trial has been done (6) which has assessed elements of the SOR. This technical memorandum places on record, the results of focus group discussions of the requirements for the Extreme Cold Weather Mitt Liner, Mortarman Glove, and Temperate Combat Glove.

Method

The method chosen to determine the deficiencies with the current handwear, and the ideal characteristics of the three types of handwear being considered in this report, was to facilitate focus group sessions with subject matter experts. For the Temperate Glove, six separate groups of soldiers were asked to discuss their opinions. These six groups consisted of members of:

- a RECCE platoon (21 soldiers) of the 3RCR in CFB Petawawa,
- 2 infantry groups (26 mostly young privates and 15 more experienced NCMs resp.) of the 3RCR in CFB Petawawa,
- members of an armoured platoon (16 soldiers) from CFB Gagetown,
- an artillery platoon (23 soldiers) from CFB Gagetown, and
- various infantry (33 soldiers) from CFB Gagetown.

They were asked to give their opinions, their likes and dislikes, of the current issue combat glove, what they bought and wore themselves if and when allowed to do so, and finally, to describe the ideal pair of temperate combat gloves. They were also asked to rank, if possible, the ideal glove characteristics with respect to their importance. A few examples of commercial gloves which were thought to exhibit some anticipated characteristics of the ideal glove were then passed around for the purpose of eliciting comments as to their perceived adequacy in meeting the requirement of their ideal combat glove.

An additional group of infantry soldiers (20 personnel) at CFB Winnipeg was selected for a focus group session on the Arctic Mitt Liner. A separate group, also from CFB Winnipeg, consisting only of mortarmen (14 personnel), was assembled to focus discussions on the ideal glove to support their operations in the field. The outline of the discussions with these two groups was similar to the previous groups on the Temperate Glove. The difference between these groups and the previous ones was that discussions on likes and dislikes of the currently issued kit were omitted, because the items being discussed are new to the inventory.

The discussions on deficiencies of current issue items and preferences of commercial products are reported for each glove. The ideas of what constituted an ideal glove were identified and ranked for each focus group. For the Temperate Combat Glove, the top five rated characteristics of each focus group were assigned a number: 5 for the most important down to 1 for fifth most important. The numbers were added for each characteristic and the results for all groups were sorted in a descending order and listed in a table. Ties were allowed. In the table, the characteristics were then further separated into three groups: high priority, arbitrarily chosen from 15 to 30, medium priority from 5

to 15, and low priority below 5. A fourth group summarises opinions on unranked glove characteristics also contained in the SOR, while a fifth group lists characteristics that were discussed, but are not mentioned in the SOR.

Results and Discussion

Temperate Combat Glove

When asked for their opinion on the current issue combat glove, all groups expressed a general dissatisfaction with this piece of kit. Most seemed to appreciate the wool liner more than the leather glove itself during cool and cold conditions. The soldiers believed that the leather shell "conducts the cold", and their hands would remain warmer if only the liner were worn. It was explained to all the groups that the current combat glove was being replaced by a cold-wet-weather glove for warmth, in wet and dry conditions, and by a temperate glove for abrasion protection in temperate (warmer) conditions. In further discussions, excluding protection from the cold, the dissatisfaction tended mainly to be the result of a lack of durability and a poor fit, thus lack of tactility/dexterity. In all groups, this discussion continued with a general agreement that the glove was acceptable for certain tasks when dry conditions prevailed, but was totally unacceptable for all tasks in wet conditions. The gloves "get wet too easy" and "dry too slowly". When they get wet, they become "slimy" and "slippery", and "shrink" and "get hard when they do eventually dry". Also, when they get wet, the "dye runs, and they (the hands) are hard to get clean". Four groups (three from Petawawa and one (artillery) from Gagetown) commented on the closure system, i.e. the elastic was not adjustable, was too tight, and was in the wrong place. It was believed that this also contributed to the glove feeling cold, as it probably cut off some of the blood circulation to the hand.

There was quite a mix of responses when asked what they actually wore in the field. The group consisting of young privates and corporals wore the current issue combat glove because "they had to". Of the remaining infantry groups, 31 out of 54 have worn flight gloves, 8 out of 21 have worn leather alternatives, and 5 out of 18 have worn polypropylene gloves. Although the flight gloves seemed to be very popular, all agreed that they suffered from durability problems. The majority of the armoured group (13/16) has used the anti-contact glove and found it acceptable. The artillery group gave various responses to this question (neoprene, cross-country, scuba, and anti-contact gloves), but there was no one favourite.

The remaining discussions focused on the important characteristics of an ideal Temperate Combat Glove, and are summarised in Table 1. In discussing the first (high priority) group of characteristics, a rather large number of personnel (> 90%) agreed that durability and fit/dexterity ranked as the most important characteristics of temperate handwear. When required, the gloves must provide thermal and abrasion protection without worrying about whether they will fall apart or rip and thus replacing them often. Opinions on the durability or minimum duration without excessive wear ranged from 2 weeks to at least a full field deployment. A change in fit characteristics is also a reason

for early replacement. Many said the current gloves do not fit properly to begin with, having fingers that are too long or too short. Once they get wet, they dry in odd configurations and become stiff. Bare hands are preferred to ill-fitting gloves for most tasks. It was noted that many found it difficult to separate fit from other essential and highly desirable glove criteria (e.g. dexterity).

Proper selection of materials, combined with proper construction/assembly techniques will give the most effective solution to the question of durability. Solutions to other factors such as abrasion protection, extra protection in certain areas of the hand (reinforcements), and shrink resistance can also be addressed by paying careful attention to material characteristics. Consideration of outer materials and liner properties (if a liner is incorporated) would also maximise the water resistance, water vapour permeability, and quick drying capabilities of the glove, as required.

The issue of fit is more difficult to satisfy. A Canadian anthropometric study has been conducted (7), and data was acquired on hand dimensions of the CF land force population. A preliminary comparison of this data with commercially off-the-shelf gloves has indicated a poor correlation of current glove sizing systems and CF hands. It has also been noted that industry is reluctant to change its sizing systems, even though a large number of the population is not properly fitted. A collaborative effort with one Canadian glove manufacturer in the Cold Wet Weather Glove project has resulted in a new sizing system that meets the fit requirement of more than 95% of the CF population (as yet unpublished data). It is thus believed that an equally acceptable sizing system for the Temperate Combat Glove can be developed with the help of industry. With a larger percentage of the population properly fitted with gloves, other issues such as improved dexterity and tactility will follow.

Thirdly, the design itself, of course, will also play a large part in the ease of donning and doffing and adjustability of the glove. By making it loose enough at the wrist to don easily, and then provide a zip strap to secure the glove in place, is the suggestion most often heard in discussions of ideal gloves.

The next group (medium priority) contained characteristics that could be classified as highly desirable to essential. It would be highly desirable for the gloves not to get wet in the first place, but if they did, it is essential that they dry quickly. It is always important that the gloves protect the hands from thermal and abrasive assaults (e.g. rappelling, traversing thick brush, and digging trenches) and thus reinforcements on the palm and thumb crotch would be highly desirable (again noted that this tied in closely with durability). Dexterity and tactility were of course necessary to do any task requiring fine finger movements. Adjustability and a well-designed closure system are important for providing and maintaining a good fit, and together with dexterity and tactility, relate strongly to the fit issue. A few soldiers discussed the advantages of a Velcro strap adjustment system, but most agreed that a zip strap was much preferred.

The third group contained characteristics ranked as desirable to highly desirable, and included water vapour permeability for sweat removal, easy donning and doffing

(related to adjustability), shrink resistance (fit related), minimum bulk (tactility and dexterity related) and be produced in a colour that blends with the rest of the clothing (camouflage). There was no consensus as to which colour was preferred, but all seemed to be earth tones with OG107 mentioned by every group.

The rest of the characteristics seen in the table are mentioned as other desirable features, but not as important as those in the preceding discussion. These last two groups also contain characteristics mentioned by only one or two groups, and were thus also deemed to be important to mention, but not important enough to most soldiers in the army to rank very high. No one seemed too concerned with the sizing details, as long as the gloves fit. There was a split in opinion as to whether this glove should have a liner, or whether the outer material should be leather or textile. One or two people in each group suggested that the colour should not "stain" their hands, and there should be a clip on the gloves for easier storage. With respect to the length of the glove, once it became a 'given' that the glove would cover the hand, the groups were split as to whether it should stop at the heel of the palm, or 1" or 2" past the palm.

Extreme Cold Weather Mitt Liner

It was generally agreed in discussions on the Arctic Mitt (with mitt liner) that this handwear provides very little manual dexterity. The group was asked to comment on how tasks, which require dexterity, are accomplished. Most replied that if the task was of a short duration, they simply went barehanded. On tasks of longer duration, a large number wore the current combat glove liner, while the remaining few wore either the anti-contact glove, or a commercial off-the-shelf wool glove. Some admitted that when allowed, they would bring a glove made for cold weather, like a ski glove, on exercise instead of the Arctic Mitt. They all agreed that they would benefit from some sort of 'glove' liner/insert for the Arctic Mitt.

Examples of tasks that require manual dexterity which members of the group would prefer to do while wearing gloves include weapon and vehicle maintenance, operating and refuelling lanterns and stoves, loading magazines, retrieving articles from pockets, tying ropes, tent routines, writing, eating, urinating and defecating, and smoking. Although it is easier to do these tasks with the combat glove liner (or facsimile), a glove which is more durable and windproof would be more appreciated.

In discussions on cold weather handwear concepts, no one wanted an outer mitt with a mitt liner. All suggested that a mitt with a glove liner was acceptable, but preferred a glove with a glove liner (discussion led by ski glove users).

In describing their concept of the ideal Arctic Mitt insert, the group first talked about a "durable glove". There might be a requirement for reinforcements on the palm and fingers for vehicle maintenance and tent routines. Windproof, waterproof and breathable was discussed together, frequently referring to Gore-Tex. It should be warm and flexible, not bulky. The topic of cost also came up on more than one occasion. If they

Table 1. Summary of Temperate Combat Glove responses of six focus groups, dealing with the design of an ideal glove.

Importance	Feature	Rank Number
High Priority	Durable	26
	Good fit / good dexterity	21
Medium Priority	Waterproof	14
	Good tactility	14
	Should have a wrist closure	9
	Must protect against the environment	9
	Quick drying	8
	Reinforced palm	6
Low Priority	Water vapour permeable	4
	Easy to don / doff	3
	Shrink resistant	3
	Not bulky	2
	Neutral colour or camouflaged	1
Other SOR Topics	Liner not required if there is a CWWG	
	Material – most preferred leather	
Other Non-SOR Topics	Colourfast dye	
	Not slimy when wet	
	Unhampered weapon use	
	Be able to write	
	No knuckle stress	
	Storage clip	
	Size by numbers	
	Length = 1" past heel of palm	

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3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title)

A preliminary study of handwear

4. AUTHORS (Last name, first name, middle initial)

Dyck, Walter R.

5. DATE OF PUBLICATION (month and year of publication of document)	6a. NO. OF PAGES (total containing information. Include Annexes, Appendices, etc)	6b. NO. OF REFS (total cited in document)
October, 1999	13	7

7. DESCRIPTIVE NOTES (the category of the document e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered)

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8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address.)

PMO CTS

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10a. ORIGINATOR'S DOCUMENT NUMBER (the official, unique, document number by which the document is identified by the originating activity)	10b. OTHER DOCUMENT NOS. (any other numbers which may be assigned to this document either by the originator or by the sponsor)
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